USER'S GUIDE

MACHINIST CALC™

MACHINING MATH AND REFERENCE TOOL

Model 4086

MACHINIST CALC™ PRO

ADVANCED MACHINING MATH AND REFERENCE TOOL

Model 4087

CALCULATED INDUSTRIES®

FAST. ACCURATE. RELIABLE.

MACHINIST CALC™ AND MACHINIST CALC™ PRO

The *Machinist Calc*™ Machining Math and Reference Tool (Model 4086) and the *Machinist Calc*™ Pro Advanced Machining Math and Reference Tool (Model 4087) both provide fast, precise solutions for your every day machining calculations. With the *Machinist Calc/ Machinist Calc Pro* you will spend less time looking up your most-needed calculations on charts, in books or on the Internet and more time machining.

This User's Guide has definitions, examples and instructions for both calculators. Information specific to a particular model is indicated in the Table of Contents and throughout the User's Guide.

Both calculators will provide you with hundreds of machining-specific calculations, including:

- Cutting Speed, Spindle Speed (RPM)
- Feed Rate, Cutting Feed, Feed per Tooth (Chip Load)
- Built-in Drill and Thread Size reference tables
- Bolt Pattern hole layouts
- Work in and convert between U.S. and Metric units, including:
    - Decimal Inches/Mils
    - Feet-Inch-Fractions
    - m, mm, cm
    - Area, Volume and Weight

In addition, the *Machinist Calc Pro* (Model 4087) has:

- Advanced Built-in Drill and Thread Size reference tables
- Drill Point Cut Depth solutions
- Wire Sizes and 3-Wire Measurements
- Advanced Bolt Pattern hole layouts with center x, y coordinate
- Right triangle math
- Trigonometric solutions

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GETTING STARTED

You may want to practice getting a feel for your calculator keys by reading through the key definitions and learning how to enter data, how to store values, etc., before proceeding to the examples.

KEY DEFINITIONS

Basic Function Keys

On/C	***On/Clear Key —*** Turns on power. Pressing once clears the last entry and the display. Pressing twice clears all non-permanent values.
Off	***Off —*** Turns all power off. Clears all non-permanent values.
+ − × ÷ =	Arithmetic operation keys.
0 - 9 and •	Keys used for entering numbers.
Conv	***Convert —*** Used with the dimensional keys to convert between units or with other keys to access special functions.
Stor	***Store —*** Used for storing values.
Stor 1 - 9	***Storage Registers M1 through M9 —*** Used to store values in Memory registers 1 through 9.
Rcl	***Recall —*** Used with other keys to recall stored values and settings.
Conv Rcl	***Memory Clear (M-R/C) —*** Clears Accumulative Memory without changing current display.
M+	***Accumulative Memory —*** Adds displayed value to Accumulative Memory.
Conv M+	***M- —*** Subtracts displayed value from Accumulative Memory.

Dimensional Function Keys

mm — ***Millimeters —*** Identifies entry as millimeters, with repeated presses toggling between linear, area and volume units. Converts dimensional value to units of millimeters, with repeated presses toggling between millimeters and meters.

Conv **5** — ***Centimeters (cm) —*** Identifies entry as centimeters, with repeated presses toggling between linear, area and volume units.

Conv **9** — ***Meters (m) —*** Identifies entry as meters, with repeated presses toggling between linear, area and volume units.

Conv **7** — ***Feet —*** Identifies entry as Feet, with repeated presses of **Conv** **7** toggling between linear, area and volume units. Also used with **Inch** and **/** for entering Feet-Inch values. Repeated presses of **Conv** **7** during conversions toggle between fractional Feet-Inch and decimal Feet.

Inch — ***Inch —*** Identifies entry as Inches, with repeated presses toggling between linear, area and volume units. Entry can be whole or decimal numbers. Also used with **/** for entering fractional Inch values (e.g., **9** **Inch** **1** **/** **2**). Repeated presses during conversions toggle between fractional and decimal Inches.

/ — ***Fraction Bar —*** Used to enter fractions. Fractions can be entered as proper (1/2, 1/8, 1/16) or improper (3/2, 9/8). If the denominator (bottom) is not entered, the calculator's fractional accuracy setting is automatically used. Results are always shown in typical dimensional fractional format.

/1000" — ***1/1000" (mils) —*** Multiplies a dimensionless entry by 0.001 Inch and displays the result as Inches. Converts a linear entry to decimal Inches. For both methods, the result is rounded and displayed to three decimal places.

Weight and Volume Function Keys

Conv 6 ***Tons —*** Enters or converts a weight or volume value to tons.

Conv 4 ***Pounds (lbs) —*** Enters or converts a weight or volume value to pounds.

Conv 3 ***Metric Tons (met tons) —*** Enters or converts a weight or volume value to metric tons.

Conv 2 ***Grams —*** Enters or converts a weight or volume value to grams.

Conv 1 ***Kilograms (kg) —*** Enters or converts a weight or volume value to kilograms.

Conv 0 ***Weight per Volume (wt/vol) —*** Stores a new weight per volume as pounds per cubic foot or other format as shown below. Default value is 490 pounds per cubic foot of steel.

- Pounds per cubic foot
- Pounds per cubic inch
- Metric tons per cubic meter
- Kilograms per cubic meter

Trigonometric Function Keys (NOT AVAILABLE ON MODEL 4086)

Conv #Teeth ***Sine —*** Calculates the Sine of an entered degree or unitless value.

Conv Adj (∞) ***Arcsine (ArcSine) —*** Calculates the angle for the entered or calculated Sine value.

Conv Feed/Tooth ***Cosine (Cos) —*** Calculates the Cosine of an entered degree or unitless value.

Conv Opp (y) ***Arccosine (ArcCos) —*** Calculates the angle for the entered or calculated Cosine value.

Conv Cut Feed ***Tangent (Tan) —*** Calculates the Tangent of an entered degree or unitless value.

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Conv Hyp — ***Arctangent (ArcTan) —*** Calculates the angle for the entered or calculated Tangent value.

Miscellaneous Functions

Conv • — ***Degrees:Minutes:Seconds (dms◄►deg) —*** Converts between D:M:S and decimal degree formats; repeated presses will toggle between the two formats.

% — ***Percentage —*** Used to find a given percent of a number.

Conv Drill Size
Model 4086
Conv %
Model 4087
— x^2 **—** Squares the value on the display.

← *Model 4087 only* — ***Backspace Function —*** Used to delete entries one keystroke at a time (unlike the On/C function, which deletes the entire entry).

Conv %
Model 4086
Conv ←
Model 4087
— ***Square Root ($\sqrt{x}$) —*** Calculates the Square Root of the number on the display.

Conv ÷ — ***Reciprocal (1/x) —*** Finds the Reciprocal of a number (e.g., 8 Conv ÷ = **0.125**).

Conv × — ***Clear All —*** Returns all stored values to the default settings. Does not affect Preference Settings.

Conv − — ***Change Sign (+/–) —*** Toggle displayed value between negative and positive value.

Conv + — ***Pi —*** Displays value of π (3.1415927).

Conv = — ***Paperless Tape (Tape) —*** Accesses the Paperless Tape mode (see ***Paperless Tape*** section), which keeps track of your past 30 entries. Useful for checking strings of numbers.

Conv Stor ***Preference Settings (Prefs) —*** Accesses various customizable settings, such as dimensional answer formats (see ***Preference Settings*** section).

Machinist Function Keys

Cut Speed ***Cutting Speed —*** Enters or calculates Cutting Speed. Unitless entries assumed feet per minute in U.S. mode; meters per minute in Metric mode. Calculates Cutting Speed given entered Diameter and RPM (Spindle Speed). Result is displayed as a whole number.

RPM ***Revolutions per Minute —*** Enters or calculates RPM (Spindle Speed). Calculates RPM given entered Diameter and Cutting Speed. Result is displayed as a whole number.

Conv RPM *Model 4087 only* ***3-Wire Measurement (3-W Measure) —*** Enters or calculates a Three-Wire Measurement. Unitless entries assumed Inches in U.S. mode; millimeters in Metric mode. Calculates the maximum Three-Wire Measurement and Pitch Diameter given entered Thread Size and Wire Size, as long as the selected Thread Classification is set to an External thread type. If a Three-Wire Measurement value is entered, the Pitch Diameter calculation is based on this entered measurement.

Feed Rate ***Feed Rate —*** Enters or calculates Feed Rate. Unitless entries assumed inches per minute in U.S. mode; millimeters per minute in Metric mode. Calculates Feed Rate given values for Cutting Feed and RPM (Spindle Speed) or Feed per Tooth (Chip Load), RPM and Number of Teeth. If all of these values are entered, the calculation based on Cutting Feed and RPM takes precedence.

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Conv Feed Rate

Model 4087 only

Wire Size — Enters or calculates Wire Size for 3-Wire Measurements. Unitless entries assumed Inches in U.S. mode; millimeters in Metric mode. Calculates the recommended Best (Ideal), Maximum and Minimum Wire Sizes given an entered Thread Size.

Bolt Pattern

Bolt Pattern — Enters the number of holes in a Bolt Pattern. Calculates the hole Center-to-Center Spacing and the x and y coordinates for each hole in a Bolt Pattern given entered Diameter, Number of Bolt Holes, Starting Angle (optional) and Center x and y coordinates (optional; Model 4087 only).

Conv Bolt Pattern

Model 4087 only

Thread Classification (Thread Class) — Used to select the Thread Class for numeric and fractional Threads and the Tolerance Class for metric Threads. The default Class for numeric and fractional Thread Sizes is 2B (Internal) and the default Tolerance Class for metric Thread Sizes is 6H (Internal). See ***Thread Sizing*** section for further details on available Classes.

Conv Bolt Pattern

Model 4086 only

Starting Angle (Start Angle) — Enters the Starting Angle of the first hole of a Bolt Pattern, with 0° being the three o'clock position and the rotation going counterclockwise.

Thread Size

Thread Size — Enters a numeric, fractional or metric Thread Size and provides Thread characteristics such as Cut Tap Drill Size, Minimum Major Diameter, etc. See ***Thread Sizing*** section for further details on entry format, valid entries and a listing of the resulting Thread characteristics.

Conv Thread Size

Model 4087 only

% Thread — Enters a non-standard Thread Grip Percentage for use in determining screw Tap Drill Sizes. Default value is 75%.

Drill Size

Drill Size — Enters a numeric, letter, fractional or metric Drill Size, displaying the decimal Inch equivalent of the Drill Size. The next smaller Drill Size is displayed if the entered value doesn't match a Drill Size. Repeated presses of Drill Size or ⊕ toggle through Drill Sizes in increasing order. Presses of ⊖ toggle through Drill Sizes in decreasing order. Selected Drill Size is stored upon exiting function.

Conv Drill Size

Model 4087 only

Drill Point — Enters the Cutting Angle of a Drill Point. Calculates the Drill Point Cut Depth that needs to be taken into account when it's necessary to maintain a specific full diameter depth.

#Teeth

Number of Teeth — Enters the Number of Teeth on a tool. Default value is 1.

Feed/ Tooth

Feed per Tooth — Enters or calculates Feed per Tooth (Chip Load). Unitless entries assumed Inches in U.S. mode; millimeters in Metric mode. Calculates Feed per Tooth given entered Cutting Feed and Number of Teeth or RPM (Spindle Speed), Feed Rate and Number of Teeth. If all of these values are entered, the calculation based on Cutting Feed and Number of Teeth takes precedence.

Cut Feed

Cutting Feed — Enters or calculates Cutting Feed. Unitless entries assumed inches per revolution in U.S. mode; millimeters per revolution in Metric mode. Calculates Cutting Feed given entered Feed per Tooth (Chip Load) and Number of Teeth or Feed Rate and RPM (Spindle Speed). If all of these values are entered, the calculation based on Feed per Tooth and Number of Teeth takes precedence.

Diam

Diameter — Enters a Diameter and calculates circle Area and Circumference given entered Diameter. On Model 4087, calculates Diameter given entered Radius.

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Conv Diam
Model 4087 only

Radius — Enters or calculates a Radius. Calculates Radius given entered Diameter.

Conv 8

Alpha — Enters alphabet character selection mode. While in this mode, a letter can be selected and used with Drill Size to enter a letter Drill Size. Entering this mode with a unitless entry between 1 and 26 will display the corresponding letter of the alphabet (i.e. 5 Conv 8 displays the letter **E**). While in Alpha mode, presses of 8 or + toggle forward through the alphabet, while presses of − toggle backward.

Adj
Model 4087 only

Adjacent (x) — Enters or calculates the Adjacent (horizontal) leg of a right triangle. Calculates Adjacent value given two other right-triangle values. Also enters the Center x-coordinate of a Bolt Pattern.

Opp
Model 4087 only

Opposite (y) — Enters or calculates the Opposite (vertical) leg or height of a right triangle. Calculates Opposite value given two other right-triangle values. Also enters the Center y-coordinate of a Bolt Pattern.

Hyp
Model 4087 only

Hypotenuse (r) — Enters or calculates the Hypotenuse (diagonal) of a right triangle. Calculates Hypotenuse value given two other right-triangle values.

Angle
Model 4087 only

Angle (θ) — Enters or calculates an Angle, providing the Adjacent Angle for both instances. Calculates an Angle given two other right-triangle values. Also enters the Starting Angle of the first hole of a Bolt Pattern, with 0° being the three o'clock position and the rotation going counterclockwise.

SETTING FRACTIONAL RESOLUTIONS

The *Machinist Calc* and *Machinist Calc Pro* are set to display fractional answers in 64ths of an Inch. All examples in this User's Guide are based on 1/64". However, you may select Fractional Resolution to be displayed in other formats (e.g., 1/16", 1/32", etc.). The methods for permanently and temporarily changing Fractional Resolution are shown in the following sections.

Permanently Set Fractional Resolution

To permanently set the Fractional Resolution, you must be in Preference Setting mode.

KEYSTROKE	DISPLAY
1. Access Preference Settings:	
Conv Stor *(Prefs)*	**FRAC 0-1/64 INCH***
2. Toggle through available Fractional Resolutions:	
+	**FRAC 0-1/2 INCH**
+	**FRAC 0-1/4 INCH**
+	**FRAC 0-1/8 INCH**
+	**FRAC 0-1/16 INCH**
+	**FRAC 0-1/32 INCH**
+ *(repeats options)*	**FRAC 0-1/64 INCH**
3. To permanently set the Fractional Resolution you have selected above, press On/C (or any key) to set the displayed Fractional Resolution and exit Preference Settings.	
On/C	**0.**
4. To recall your selected Fractional Resolution:	
Rcl /	**STD 0-1/64 INCH**

** 1/64" is the default setting. The display may differ from the example depending on what the resolution is currently set to.*

Temporarily Set Fractional Resolution

You can also convert a fractional value to a different resolution temporarily while solving a problem. In the example below, add 1/64th to 44/64th of an Inch and then convert the answer to other Fractional Resolutions:

KEYSTROKE	DISPLAY
On/C On/C	**0.**
4 4 / 6 4	**0-44/64 INCH**
+ 1 / 6 4 =	**0-45/64 INCH**
Conv 1 *(1/16)*	**0-11/16 INCH**
Conv 2 *(1/2)*	**0-1/2 INCH**
Conv 3 *(1/32)*	**0-23/32 INCH**
Conv 4 *(1/4)*	**0-3/4 INCH**
Conv 6 *(1/64)*	**0-45/64 INCH**
Conv 8 *(1/8)*	**0-3/4 INCH**
On/C On/C *	**0.**

** Changing the Fractional Resolution on a displayed value does not alter your Permanent Fractional Resolution Setting (set in Preference Settings).*

***Note:** This setting is temporary; it will revert back to your Permanent Fractional Setting upon press of On/C or when you turn the calculator off.*

PREFERENCE SETTINGS

Press Conv, then Stor to access the Preferences menu. Continue pressing Stor to toggle through different Preferences. Press + or − keys to toggle between options of the different Preferences. Press On/C to exit Preferences. Your calculator will keep your Preference Settings until a Full Reset alters your settings to the default values (see ***Appendix*** for more information).

KEYSTROKE	DISPLAY
Conv Stor Stor *(Prefs)*	
(Functional Result Rounding)	**F-RND 0.0000**
+	**F-RND 0.000**
+	**F-RND FLOAT**
+ *(repeats options)*	**F-RND 0.0000**
Third press of Stor:	
(Default Unit Format)	**US UnITS**
+	**METRC UnITS**
+ *(repeats options)*	**US UnITS**
Fourth press of Stor:	
(Area Answer Format)	**AREA Std.**
+	**AREA 0. SQ FEET**
+	**AREA 0. SQ INCH**
+	**AREA 0. SQ M**
+ *(repeats options)*	**AREA Std.**
Fifth press of Stor:	
(Volume Answer Format)	**VOL Std.**
+	**VOL 0. CU FEET**
+	**VOL 0. CU M**
+	**VOL 0. CU INCH**
+ *(repeats options)*	**VOL Std.**
Sixth press of Stor:	
(Fractional Mode)	**FRAC Std.**
+	**FRAC COnST**
+ *(repeats options)*	**FRAC Std.**
Seventh press of Stor:	
(Mathematical Operation)	**MATH OrDEr**
+	**MATH CHAIn**
+ *(repeats options)*	**MATH OrDEr**

ENTERING DIMENSIONS

Note: *Unlike other Calculated Industries/Construction Master calculators, the* Machinist Calc *and* Machinist Calc Pro *do not have a dedicated Feet key. Feet is a secondary function located above the* 7 *key, so you have to use the* Conv *key, then* 7 *to enter or calculate dimensions using Feet. Below are some examples.*

Enter 2 Feet, then label as square and cubic units:

DIMENSIONS	KEYSTROKE	DISPLAY
2 Feet	2 Conv 7	2 FEET
2 square Feet	Conv 7	2 SQ FEET
2 cubic Feet	Conv 7	2 CU FEET

Enter 2 Feet, 3 Inches:

KEYSTROKE	DISPLAY
2 Conv 7 3 Inch	2 FEET 3 INCH

Linear Dimensions

Examples of how linear dimensions are entered (press On/C after each entry):

DIMENSIONS	KEYSTROKE
23 mils	2 3 /1000"
4.5 Inches	4 • 5 Inch
95 millimeters	9 5 mm
1,320 Feet	1 3 2 0 Conv 7
201 meters	2 0 1 Conv 9

Square and Cubic Dimensions

Examples of how square and cubic dimensions are entered (press On/C after each entry):

DIMENSIONS	KEYSTROKE
14 square Inches	1 4 Inch Inch
11 square millimeters	1 1 mm mm
1.5 cubic meters	1 • 5 Conv 9 9 9
3 cubic Feet	3 Conv 7 Conv 7 Conv 7

CONVERSIONS

Linear Conversions

Convert 10 Feet 6 Inches to other dimensions, including metric:

KEYSTROKE	DISPLAY
On/C On/C	**0.**
1 0 Conv 7 6 Inch	**10 FEET 6 INCH**
Conv /1000" *	**126.000 INCH**
Conv 7 *(Feet)*	**10.5 FEET**
Conv Inch	**126. INCH**
Conv mm	**3200.4 MM**
Conv 5 *(cm)*	**320.04 CM**
Conv 9 *(m)*	**3.2004 M**

**Converting a linear value using the /1000" key will result in the decimal Inch equivalent of the value, rounded to three decimal places. Only unitless values are multiplied by 0.001 Inches when using this key.*

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Convert 15 Feet 9-1/2 Inches to decimal Feet. Then convert back to Feet-Inch-Fractions.

KEYSTROKE	DISPLAY
On/C On/C	0.
1 5 Conv 7 9 Inch 1 / 2	15 FEET 9-1/2 INCH
Conv 7 *(Feet)*	15.791667 FEET
Conv 7	15 FEET 9-1/2 INCH

Convert 17.32 Feet to Feet-Inch-Fractions:

KEYSTROKE	DISPLAY
On/C On/C	0.
1 7 • 3 2 Conv 7 *(Feet)*	17.32 FEET
= Conv 7	17 FEET 3-27/32 INCH
Conv 7	17.32 FEET
Conv Inch	207.84 INCH
Conv 7 Conv 7	17 FEET 3-27/32 INCH

Convert 8-1/8 Inches to decimal Inches. Then convert to decimal Feet.

KEYSTROKE	DISPLAY
On/C On/C	0.
8 Inch 1 / 8	8-1/8 INCH
Conv Inch	8.125 INCH
Conv 7 *(Feet)*	0.6770833 FEET

Convert 9.0625 Inches to fractional Inches. Then convert to decimal Feet.

KEYSTROKE	DISPLAY
On/C On/C	0.
9 • 0 6 2 5 Inch	9.0625 INCH
Conv 7 *(Feet)*	0.7552083 FEET

Square and Cubic Conversions

Convert 6 square Feet to other square dimensions:

KEYSTROKE	DISPLAY
On/C On/C	0.
6 Conv 7 Conv 7 *(Feet)*	6 SQ FEET
Conv mm	557418.24 SQ MM
Conv 9 *(m)*	0.5574182 SQ M
Conv 5 *(cm)*	5574.1824 SQ CM

Convert 0.05 cubic meters to other dimensions:

KEYSTROKE	DISPLAY
On/C On/C	0.
• 0 5 Conv 9 9 9 *(m)*	0.05 CU M
Conv mm	50000000. CU MM
Conv 5 *(cm)*	50000. CU CM
Conv Inch	3051.1872 CU INCH
Conv 7 *(Feet)*	1.7657333 CU FEET

Weight Conversions

Convert 1.5 tons to pounds and kilograms:

KEYSTROKE	DISPLAY
On/C On/C	0.
1 • 5 Conv 6 *(tons)*	1.5 TON
Conv 1 *(kg)*	1360.7771 KG
Conv 4 *(lbs)*	3000. LBS

Weight per Volume and Volume Conversions

Convert 2 cubic Feet of stainless steel to pounds, tons, kilograms, and metric tons if the steel weighs 7,480 kilograms per cubic meter.

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KEYSTROKE	DISPLAY
On/C On/C	**0.**
1. Store the weight per volume:	
7 4 8 0 Stor 0 0 0 0 * *(wt/vol)*	S **7480. KG/ CU M**
2. Enter steel volume:	
2 Conv 7 Conv 7 Conv 7	**2 CU FEET**
3. Convert to pounds, tons, kilograms and metric tons:	
Conv 4 *(lbs)*	**933.92229 LBS**
Conv 6 *(tons)*	**0.4669611 TON**
Conv 1 *(kg)*	**423.62003 KG**
Conv 3 *(met tons)*	**0.42362 MTON**
4. Change the weight per volume back to the default value:	
4 9 0 Stor 0 0 *(wt/vol)*	S **490. LBS/ CU FEET**

** The number of 0 presses may vary, depending on the last units displayed when wt/vol was last recalled/stored. By default, pounds per cubic foot is displayed first.*

BASIC MATH OPERATIONS

Adding and Subtracting Dimensions

Add the following measurements:
- 6 Feet 2-1/2 Inches
- 11 Feet 5-1/4 Inches
- 18.25 Inches

Then subtract 2-1/8 Inches.

KEYSTROKE	DISPLAY
6 Conv 7 2 Inch 1 / 2 +	**6 FEET 2-1/2 INCH**
1 1 Conv 7 5 Inch 1 / 4 +	**17 FEET 7-3/4 INCH**
1 8 • 2 5 Inch =	**19 FEET 2 INCH**
− 2 Inch 1 / 8 =	**18 FEET 11-7/8 INCH**

Multiplying Dimensions

Multiply 5 Feet 3 Inches by 11 Feet 6-1/2 Inches:

KEYSTROKE	DISPLAY
5 Conv 7 3 Inch ×	5 FEET 3 INCH
1 1 Conv 7 6 Inch 1 / 2 =	60.59375 SQ FEET

Multiply 2 Feet 7 Inches by 10:

KEYSTROKE	DISPLAY
2 Conv 7 7 Inch × 1 0 =	25 FEET 10 INCH

Dividing Dimensions

Divide 30 Feet 4 Inches by 7 Inches:

KEYSTROKE	DISPLAY
3 0 Conv 7 4 Inch ÷ 7 Inch =	52.

Divide 20 Feet 3 Inches by 9:

KEYSTROKE	DISPLAY
2 0 Conv 7 3 Inch ÷ 9 =	2 FEET 3 INCH

Calculating Percentages

The % key can be used for finding a given percent of a number or for working add-on, discount or division percentage calculations. It can be used with any type of number, in any dimension (Feet, Inch, millimeter, etc.) and any type of convention (non-dimensioned, linear, square or cubic).

Find 18% of 50 Feet:

KEYSTROKE	DISPLAY
On/C On/C	0.
5 0 Conv 7 × 1 8 %	9 FEET 0 INCH

Take 20% from 17 Feet 6 Inches:

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KEYSTROKE	DISPLAY
17 Conv 76 Inch − 20 %	14 FEET 0 INCH

MEMORY OPERATION

Whenever the M+ key is pressed, the displayed value will be added to the Memory. Other Memory functions:

FUNCTION	KEYSTROKE
Add to Memory	M+
Subtract from Memory	Conv M+
Recall total in Memory	Rcl M+
Display/Clear Memory	Rcl Rcl
Clear Memory	Conv Rcl

Memory is semi-permanent, clearing only when you do one of the following:

- turn off the calculator
- press Rcl Rcl
- press Conv Rcl
- press Conv ⊠ *(Clear All)*.

When Memory is recalled (Rcl M+), consecutive presses of M+ will display the calculated Average and total Count of the accumulated values.

Using M+

KEYSTROKE	DISPLAY
355 M+	M+ 355. M
255 M+	M+ 255. M
745 Conv M+ *(M-)*	M- 745. M
Rcl M+	TOTAL - 135. M
M+	AVG - 45. M
M+	COUNT 3. M
Rcl Rcl	M+ - 135.

Using Memory Storage Keys (M1- M9)

In addition to the standard cumulative Memory (as previously described), your calculator has nine independent Storage Registers – M1 through M9 – that can be used to permanently store single, noncumulative values. The following example shows the use of M1 (Stor 1). To use M2 - M9, replace the presses of the 1 key with presses of the corresponding number key (2-9).

You can replace a value in one of these Memory registers by storing a new value in place of the stored value.

FUNCTION	KEYSTROKE
Store single value in M1	Stor 1
Clear M1	0 Stor 1
Recall M1	Rcl 1

Store 175 into M1, recall the value, and then clear the value:

KEYSTROKE	DISPLAY
1 7 5 Stor 1	MEM-1 S 175.
Off On/C	0.
Rcl 1	MEM-1 S 175.
0 Stor 1	MEM-1 S 0.

PAPERLESS TAPE OPERATION

The Paperless Tape allows you to display and review the last thirty entries of a regular math or basic dimensional math sequence.

To access this mode after entering values, press Conv ⊜. Then, press ⊕ or ⊖ to scroll forward or backward through the entries.

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While in the Paperless Tape mode, the display will show the previously entered or calculated value, along with the sequential number of the entry (e.g., 01, 02, 03, etc.) and the math operator (+, –, x, ÷, %) in the upper left corner of the display.

***Note**: If = has been used in the middle of a sequence, SUB (for Subtotal) will display in the upper left. If = was the last operation performed, the display will show TTL (Total) as the last entry.*

To exit this mode, press = to exit and maintain the last entry on the display. When exiting, the last entry (or TTL) will be displayed, allowing you to continue using the last tape value for another operation, if desired.

Note: The Paperless Tape is cleared when you do one of the following:
- On/C is pressed twice
- upon a new calculation (new equation string is started)
- when the calculator is shut off.

Add a sequence of values and access Paperless Tape mode to review your entries. Then, add another value to your total.

KEYSTROKE	DISPLAY
1. Add a sequence of values:	
On/C On/C	**0.**
4 Inch +	**4 INCH**
7 Inch 1 / 2 +	**11-1/2 INCH**
6 Inch +	**17-1/2 INCH**
3 Inch 3 / 4 =	**21-1/4 INCH**
2. Access the Tape function:	
Conv =	**TTL = 21-1/4 INCH**

KEYSTROKE	DISPLAY
3. Scroll from first value to total:	
[+]	**01 4 INCH**
[+]	**02+ 7-1/2 INCH**
[+]	**03+ 6 INCH**
[+]	**04+ 3-3/4 INCH**
[+]	**TTL = 21-1/4 INCH**
4. Scroll last two values:	
[−]	**04+ 3-3/4 INCH**
[−]	**03+ 6 INCH**
5. Exit Tape function and add another value to your total:	
[=]	**TTL = 21-1/4 INCH**
[+]	**21-1/4 INCH**
[3] [Inch] [1] [/] [2] [=]	**24-3/4 INCH**

USING THE *MACHINIST CALC/ MACHINIST CALC PRO*

IMPORTANT: *All examples are based on the default U.S. units mode, displaying entries and calculations in U.S. units. Also note that if an attempt is made to find a solution (using the Machinist functions) without having stored the minimum required values, the calculation will not be performed. Instead, the currently stored value for the selected function will be displayed. See* **Key Definitions** *section for function requirements.*

CUTTING SPEED

Cutting Speed is the speed of the workpiece surface relative to the edge of the cutting tool during a cut, typically measured in surface feet per minute. You can calculate Cutting Speed by entering the Diameter of the tool or material you're using and the RPM (Spindle Speed).

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Cutting Speed – *Milling*

Calculate the Cutting Speed for a mill using a 1/2" tool running at 1,250 RPM (Spindle Speed):

KEYSTROKE	DISPLAY
On/C On/C	**0.**
1. Enter the Diameter of the tool:	
1 / 2 Diam	**DIA S 0-1/2 INCH**
2. Enter the RPM:	
1 2 5 0 RPM	**RPM S 1250.**
3. Calculate the Cutting Speed:	
Cut Speed *	**CUT 164. FEET/MIN**
Cut Speed	**DIA S 0-1/2 INCH**
Cut Speed	**RPM S 1250.**
Rcl Cut Speed *	**CUT S 163.62462 FEET/MIN**

** The calculated Cutting Speed is displayed as a rounded, whole number value. Rcl Cut Speed displays the stored Cutting Speed value in decimal floating point format.*

Cutting Speed - *Turning*

Calculate the Cutting Speed when turning a four-inch rod at 300 RPM (Spindle Speed):

KEYSTROKE	DISPLAY
On/C On/C	**0.**
1. Enter the Diameter of the rod:	
4 Inch Diam	**DIA S 4 INCH**
2. Enter the RPM:	
3 0 0 RPM	**RPM S 300.**
3. Calculate the Cutting Speed:	
Cut Speed *	**CUT 314. FEET/MIN**

** Repeated presses of Cut Speed will toggle through the inputs and outputs, starting with the entered Diameter.*

Cutting Speed - *Drilling*

Calculate the Cutting Speed using a 10.5 mm drill bit with the Spindle Speed set to 750 RPM:

KEYSTROKE	DISPLAY
On/C On/C	**0.**
1. Enter the Diameter of the hole to be drilled:	
1 0 • 5 mm Diam	**DIA S 10.5 MM**
2. Enter the RPM:	
7 5 0 RPM	**RPM S 750.**
3. Calculate the Cutting Speed:	
Cut Speed *	**CUT 81. FEET/MIN**

** Repeated presses of Cut Speed will toggle through the inputs and outputs, starting with the entered Diameter.*

Cutting Speed – *Using Metric Mode*

If you know you're going to be making your calculations in metric units, you can easily set your calculator to Metric Mode prior to entering values.

Calculate the Cutting Speed when using a #1 drill at 750 RPM (Spindle Speed):

KEYSTROKE	DISPLAY
On/C On/C	**0.**
1. Set calculator to Metric Mode:	
Conv Stor Stor Stor +	**METRC UnITS**
2. Enter the Drill Size:	
1 Drill Size	**1 DRILL SIZE S 0.2280 INCH**

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KEYSTROKE	DISPLAY
3. Store as the Diameter:	
= Diam	DIA S 0.228 INCH
4. Enter the RPM:	
7 5 0 RPM	RPM S 750.
5. Calculate the Cutting Speed:	
Cut Speed *	CUT 14. M/MIN
6. Return calculator to U.S. Mode:	
Conv Stor Stor Stor +	US UnITS

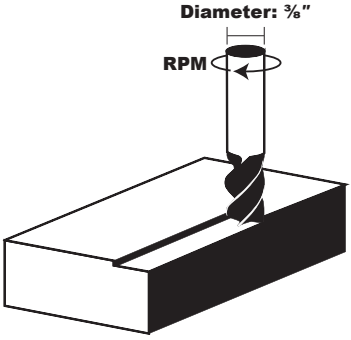
** Repeated presses of Cut Speed will toggle through the inputs and outputs, starting with the entered Diameter.*

RPM (SPINDLE SPEED)

RPM is the rotational speed of the spindle in revolutions per minute. In a milling machine or drill, the Spindle Speed is the rotation of the attached cutting tool. In a turning machine, it is the rotation of the attached workpiece. RPM can be calculated given values for Diameter and Cutting Speed.

RPM - *Milling*

Calculate the Spindle Speed (RPM) when milling with a 3/8” bit at a Cutting Speed of 300 sfm (surface feet per minute):



KEYSTROKE	DISPLAY
On/C On/C	**0.**
1. Enter the bit Diameter:	
3 / 8 Diam	**DIA S 0-3/8 INCH**
2. Enter the Cutting Speed:	
3 0 0 Cut Speed	**CUT S 300. FEET/MIN**
3. Calculate the Spindle Speed (RPM):	
RPM	**RPM 3056.**
RPM	**CUT S 300. FEET/MIN**
RPM	**DIA S 0-3/8 INCH**
Rcl RPM *	**RPM S 3055.7749**

** The calculated RPM is displayed as a rounded, whole number value. Rcl RPM displays the stored RPM value in decimal floating point format.*

RPM - *Turning*

Calculate the Spindle Speed (RPM) needed to turn a piece with a 5” Diameter at a recommended Cutting Speed of 650 sfm:

KEYSTROKE	DISPLAY
On/C On/C	**0.**
1. Enter the bit Diameter:	
5 Inch Diam	**DIA S 5 INCH**
2. Enter the Cutting Speed:	
6 5 0 Cut Speed	**CUT S 650. FEET/MIN**
3. Calculate the Spindle Speed (RPM):	
RPM *	**RPM 497.**

** Repeated presses of RPM will toggle through the inputs and outputs, starting with the entered Cutting Speed.*

RPM - *Drilling*

Calculate what the RPM (Spindle Speed) should be set to when drilling into material with a recommended Cutting Speed of 90 sfm using a 5/8” bit:

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Enter the Diameter:	
5 / 8 Diam	DIA S 0-5/8 INCH
2. Enter the Cutting Speed:	
9 0 Cut Speed	CUT S 90. FEET/MIN
3. Calculate the RPM:	
RPM *	RPM 550.

** Repeated presses of RPM will toggle through the inputs and outputs, starting with the entered Cutting Speed.*

FEED PER TOOTH (CHIP LOAD)

Feed per Tooth, or Chip Load, is the thickness of material removed by each cutting surface. You can calculate Feed per Tooth given values for Number of Teeth and Cutting Feed. If the Cutting Feed is not known, the Feed per Tooth can be calculated given values for Number of Teeth, Feed Rate and RPM (Spindle Speed).

Feed per Tooth – *Based on Cutting Feed and # of Teeth*

Calculate Feed per Tooth (Chip Load) with a Cutting Feed of 0.024 Inches for 4 Teeth:

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Enter the Cutting Feed:	
• 0 2 4 Cut Feed	CUT S 0.024 INCH/REV

KEYSTROKE	DISPLAY
2. Enter the Number of Teeth:	
4 #Teeth	**TEETH S 4.**
3. Calculate the Feed per Tooth:	
Feed/Tooth	**FPT 0.0060 INCH**
Feed/Tooth	**TEETH S 4.**
Feed/Tooth	**CUT S 0.024 INCH/REV**

Feed per Tooth – *Based on Feed Rate, RPM and # of Teeth*

Calculate Feed per Tooth (Chip Load) with a 12.8 Inch per minute Feed Rate, 4 Teeth and a Spindle Speed of 800 RPM:

KEYSTROKE	DISPLAY
On/C On/C	**0.**
1. Enter the Feed Rate:	
1 2 • 8 Feed Rate	**FEED S 12.8 INCH/MIN**
2. Enter the Number of Teeth:	
4 #Teeth	**TEETH S 4.**
3. Enter the Spindle Speed (RPM):	
8 0 0 RPM	**RPM S 800.**
4. Calculate the Feed per Tooth:	
Feed/Tooth *	**FPT 0.0040 INCH**

** Repeated presses of Feed/Tooth will toggle through the inputs and outputs, starting with the entered Number of Teeth.*

CUTTING FEED

Cutting Feed is the distance the cutting tool or workpiece advances during one revolution of the spindle, typically measured in inches per revolution (IPR). You can calculate Cutting Feed given values for Feed per Tooth (Chip Load) and Number of Teeth. If these values are unknown, you can calculate Cutting Feed with Feed Rate and RPM (Spindle Speed).

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Cutting Feed – *Based on Feed per Tooth and # of Teeth*

Calculate Cutting Feed with a Feed per Tooth (Chip Load) of 0.005 Inch and 4 Teeth:

KEYSTROKE	DISPLAY
On/C On/C	**0.**
1. Enter the Feed per Tooth:	
• 0 0 5 Feed/Tooth	**FPT S 0.005 INCH**
2. Enter the Number of Teeth:	
4 #Teeth	**TEETH S 4.**
3. Calculate the Cutting Feed:	
Cut Feed	**CUT 0.0200 INCH/REV**
Cut Feed	**FPT S 0.005 INCH**
Cut Feed	**TEETH S 4.**

Cutting Feed – *Based on Feed Rate and RPM*

Calculate a Cutting Feed using a 15-Inch Feed Rate and a Spindle Speed of 800 RPM:

KEYSTROKE	DISPLAY
On/C On/C	**0.**
1. Enter the Feed Rate:	
1 5 Feed Rate	**FEED S 15. INCH/MIN**
2. Enter the Spindle Speed (RPM):	
8 0 0 RPM	**RPM S 800.**
3. Calculate the Cutting Feed:	
Cut Feed *	**CUT 0.0188 INCH/REV**

** Repeated presses of Cut Feed will toggle through the inputs and outputs, starting with the entered Feed Rate.*

FEED RATE

Feed Rate is the speed of the cutting tool's movement relative to the workpiece as the tool makes a cut. You can calculate Feed Rate given values for Cutting Feed and RPM (Spindle Speed). If you don't know the Cutting Feed, you can calculate Feed Rate with Feed per Tooth (Chip Load), Number of Teeth and RPM.

Feed Rate – *Based on Cutting Feed and RPM (for Turning)*

Calculate the Feed Rate if you are turning a 1" steel round stock down with a Cutting Feed of 0.031 Inches per revolution and a rotational speed of 900 RPM (Spindle Speed):

KEYSTROKE	DISPLAY
On/C On/C	**0.**
1. Enter the Cutting Feed:	
• 0 3 1 Cut Feed	**CUT S 0.031 INCH/REV**
2. Enter the RPM:	
9 0 0 RPM	**RPM S 900.**
3. Calculate the Feed Rate:	
Feed Rate	**FEED 27.9000 INCH/MIN**
Feed Rate	**RPM S 900.**
Feed Rate	**CUT S 0.031 INCH/REV**

Feed Rate – *Based on Cutting Feed and RPM (for Drilling)*

Calculate the Feed Rate for a drilling operation that is using a recommended Cutting Feed of 0.004 Inches per revolution at 800 RPM (Spindle Speed):

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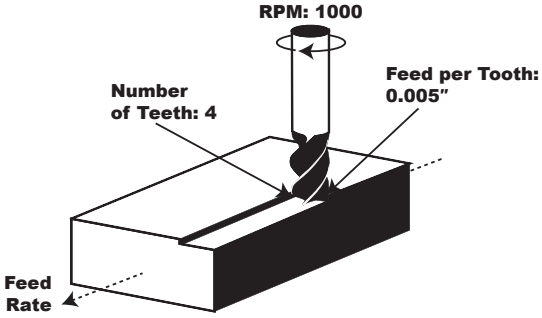
KEYSTROKE	DISPLAY
On/C On/C	0.
1. Enter the Cutting Feed:	
• 0 0 4 Cut Feed	CUT S 0.004 INCH/REV
2. Enter the RPM:	
8 0 0 RPM	RPM S 800.
3. Calculate the Feed Rate:	
Feed Rate *	FEED 3.2000 INCH/MIN

** Repeated presses of Feed Rate will toggle through the inputs and outputs, starting with the entered RPM (Spindle Speed).*

Feed Rate – *Based on Feed per Tooth, RPM and # of Teeth*

Calculate the Feed Rate for a four-fluted end mill using a Feed per Tooth (Chip Load) of 0.005" turning at 1,000 RPM (Spindle Speed):



KEYSTROKE	DISPLAY
On/C On/C	0.
1. Enter the Feed per Tooth:	
• 0 0 5 Feed/ Tooth	FPT S 0.005 INCH
2. Enter the Number of Teeth:	
4 #Teeth	TEETH S 4.
3. Enter the RPM:	

KEYSTROKE	DISPLAY
1000 RPM	RPM S 1000.

4. Calculate the Feed Rate:

Feed Rate *	FEED 20.0000 INCH/MIN

** Repeated presses of Feed Rate will toggle through the inputs and outputs, starting with the entered RPM (Spindle Speed).*

DRILL SIZES

The Drill Size key allows the selection of a desired Drill Size, which can be entered as a:

- Numeric value (whole digits 1 through 97)
- Letter between A and Z
- Fractional or decimal Inch value (max. of 3-1/2")
- Millimeter value (max. of 78 mm).

The selected Drill Size is displayed along with its decimal Inch equivalent. If the entered value doesn't match a Drill Size, the next smaller size is displayed. You can toggle through the available sizes in increasing order with either the Drill Size key or the + key. The − key displays the available sizes in decreasing order. To set the displayed Drill Size, press On/C (or any other key).

Numeric Drill Size Entry

Enter a #36 Drill and toggle through the next larger available sizes:

KEYSTROKE	DISPLAY
On/C On/C	0.

1. Enter the Drill Size:

36 Drill Size	36 DRILL SIZE S 0.1065 INCH

2. Display the next larger available sizes:

Drill Size	2_75 MM DRILL SIZE S 0.1083 INCH
Drill Size	7/64 DRILL SIZE S 0.1094 INCH
Drill Size *	35 DRILL SIZE S 0.1100 INCH

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** Repeated presses of Drill Size display the next larger Drill Sizes. The + and − keys will toggle forward and backward, respectively, through all available Drill Sizes.*

Letter Drill Size Entry

You can enter letter Drill Sizes by selecting an alphabet character via Alpha Mode (Conv 8) and then storing it using the Drill Size key. The desired letter can be selected by toggling through Alpha Mode until the letter is reached or by specifying the numerical order of the letter within the alphabet prior to entering Alpha Mode. Both methods are shown below.

Select Drill Size E by toggling though Alpha Mode. Then, select Drill Size G by entering the numerical order of the letter (the letter G is 7th in the alphabet).

KEYSTROKE	DISPLAY
On/C On/C	**0.**
1. Enter Alpha Mode:	
Conv 8 *(Alpha)*	**ALPHA A**
2. Toggle until the letter E is displayed:	
8 8 8 8	**ALPHA E**
3. Enter as Drill Size:	
Drill Size	**E DRILL SIZE S 0.2500 INCH**
4. View next larger available sizes:	
Drill Size	**6_40 MM DRILL SIZE S 0.2520 INCH**
Drill Size	**6_50 MM DRILL SIZE S 0.2559 INCH**
Drill Size *	**F DRILL SIZE S 0.2570 INCH**
5. Enter order of letter G and enter Alpha Mode:	
7 Conv 8 *(Alpha)*	**ALPHA G**
6. Enter as Drill Size:	
Drill Size *	**G DRILL SIZE S 0.2610 INCH**

** Repeated presses of [Drill Size] display the next larger Drill Sizes. The [+] and [−] keys will toggle forward and backward, respectively, through all available Drill Sizes.*

Inch Drill Size Entry

Enter hole sizes of 0.3", 1" and 1-19/64". After entering each size, toggle through the available sizes to view the next larger and next smaller sizes.

KEYSTROKE	DISPLAY
[On/C] [On/C]	**0.**
1. Enter the 0.3" hole size and view next larger and next smaller sizes:	
[•] [3] [Inch] [Drill Size]	**7_60 MM DRILL SIZE S 0.2992 INCH**
[Drill Size]	**N DRILL SIZE S 0.3020 INCH**
[−] [−]	**19/64 DRILL SIZE S 0.2969 INCH**
2. Enter the 1" hole size and view next larger and next smaller sizes:	
[1] [Inch] [Drill Size]	**1 DRILL SIZE S 1.0000 INCH**
[Drill Size]	**25_50 MM DRILL SIZE S 1.0039 INCH**
[−] [−]	**63/64 DRILL SIZE S 0.9844 INCH**
3. Enter the 1-19/64" hole size and view next larger and next smaller sizes:	
[1] [Inch] [1] [9] [/] [6] [4] [Drill Size]	**19/64 DRILL SIZE S 1.2969 INCH ***
[Drill Size]	**33_00 MM DRILL SIZE S 1.2992 INCH**
[−] [−]	**9/32 DRILL SIZE S 1.2813 INCH ***

** Note that even though the Drill Size is shown on the upper left of the display without the whole inch value (e.g. 19/64 instead of 1-19/64), the decimal inch equivalent reflects the actual size.*

Millimeter Drill Size Entry

Enter a 5.7 mm hole size and toggle through the available sizes to view the next larger and next smaller sizes:

KEYSTROKE	DISPLAY
On/C On/C	**0.**
1. Enter the hole size as millimeters:	
5 • 7 mm Drill Size	**5_70 MM DRILL SIZE S 0.2244 INCH**
2. View next larger and next smaller sizes:	
Drill Size	**5_75 MM DRILL SIZE S 0.2264 INCH**
− −	**2 DRILL SIZE S 0.2210 INCH**

DRILL POINT (NOT AVAILABLE ON MODEL 4086)

The Drill Point function calculates the Drill Point Cut Depth (length) of the stored Drill Size. By default, the calculation is based on a Cutting Angle of 118°. If a different Angle is desired, it can be stored using the Drill Point function (for example, 1 2 0 Conv Drill Size stores 120°).

Find the Drill Point Cut Depth for a 1/2-Inch drill with a 118° Cutting Angle. Then, find the Cut Depth using a 127° Angle.

KEYSTROKE	DISPLAY
On/C On/C	**0.**
1. Enter the Drill Size:	
1 / 2 Drill Size	**1/2 DRILL SIZE S 0.5000 INCH**
2. Enter 118° Angle and calculate the Drill Point Cut Depth:	
1 1 8 Conv Drill Size *(Drill Point)*	**DEPTH DRILL 0.1502 INCH**
Drill Size	**ANGLE DRILL S 118.°**
Drill Size	**1/2 DRILL SIZE S 0.5000 INCH**
3. Enter 127° angle and calculate the Drill Point cut length:	
1 2 7 Conv Drill Size *(Drill Point)*	**DEPTH DRILL S 0.1246 INCH**

THREAD SIZING

Basic Thread Sizing

On both *Machinist Calc* and *Machinist Calc Pro*, the Thread Size key allows you to enter a numeric, fractional or metric Thread Size and then toggle through the various available Thread characteristics, as shown in the tables provided later in this section.

When using the Thread Size key, the first entry is considered the Thread Size. Upon entering the Thread Size, the Threads per Inch (TPI) or Pitch is required. If the entered Thread Size is a standard size, continuous presses of the Thread Size key will toggle through the available common TPI or Pitches. Once the desired TPI/Pitch is reached, pressing On/C stores the Thread Size. If the Thread Size you enter is not a standard size or if you have a non-common TPI/Pitch, you will need to directly enter the TPI/Pitch value, pressing Thread Size after entering it in order to store the Thread Size. Both of these entry methods are covered in the examples provided within this section.

The following specifies the entry ranges that the calculator allows for the Thread Size and TPI/Pitch values for numeric, fractional and metric Thread Sizes:

	Thread Size	TPI/Pitch
Numeric	0, 1, 2, 3, 4, 5, 6, 8, 10, 12, 14	less than 100
Fractional	0.06” to 6”	less than 100
Metric	1 mm to 300 mm	less than or equal to 10

Note: *Entries outside of the ranges mentioned above will result in an Entry Error.*

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The following tables list the available Thread characteristics provided by the Thread Size function on each model. Note that Model 4087 has two separate listings, one for Internal Threads and one for External Threads. The listing shown within the Thread Size function is determined by the set Thread Classification (see ***Thread Classification*** section).

Model 4086 (Internal Thread)

Thread Size
Cut Tap Drill Size*
Thread OD (Minimum Major Diameter)

Model 4087 (Internal Thread)

Thread Size	Minimum Pitch Diameter
Cut Tap Drill Size*	Maximum Pitch Diameter
Roll Tap Drill Size*	Minimum Minor Diameter
Close Fit Drill Size*	Maximum Minor Diameter
Free Fit Drill Size*	Minimum Major Diameter

** If the resulting hole size is greater than 2 Inches or 50 mm, the actual hole size will be displayed instead of adjusting to the closest Drill Size.*

Model 4087 (External Thread)

Thread Size	Minimum Pitch Diameter
Cut Rod Size	Maximum Major Diameter
Roll Shank Size	Minimum Major Diameter
Maximum Pitch Diameter	Maximum Minor Diameter

Numeric Thread Size – *Model 4086*

Enter a # 8 screw and toggle through the available common Thread per Inch (TPI) values, store the selected Thread Size and toggle through the available Thread characteristics:

KEYSTROKE	DISPLAY
On/C On/C	**0.**
1. Enter the Thread Size:	
8 Thread Size	**SIZE 8 –**
2. Toggle through the common TPI values:	
Thread Size	**THRED SIZE S 8 – 32**
Thread Size	**THRED SIZE S 8 – 36**
Thread Size	**THRED SIZE S 8 – 32**
3. Clear the display and then recall the stored Thread Size:	
On/C *	**0.**
Thread Size	**THRED SIZE S 8 – 32**
4. Find the recommended Cutting Tap Hole Size (Cut Tap Drill Size) and the Thread Outside Diameter (Minimum Major Diameter):	
Thread Size *(Cut Tap Drill Size)*	**TAP DRILL SIZE 29**
Thread Size *(Outside Diameter)*	**OD SIZE 0.1640 INCH**

** In addition to clearing the display, pressing On/C upon reaching the desired TPI stores the displayed Thread Size.*

You can also directly enter a Thread per Inch value instead of toggling through the available ones. For this example, enter a number 6 screw with 32 TPI and toggle through the available Thread characteristics.

KEYSTROKE	DISPLAY
On/C On/C	**0.**
1. Enter the Thread Size:	
6 Thread Size	**SIZE 6 –**
2. Enter the TPI and store the final Thread Size:	
3 2 Thread Size *	**THRED SIZE S 6 – 32**

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KEYSTROKE	DISPLAY

3. Find the recommended Cutting Tap Hole Size (Cut Tap Drill Size) and the Thread Outside Diameter (Minimum Major Diameter):

Thread Size *(Cut Tap Drill Size)*	**TAP DRILL SIZE 36**
Thread Size *(Outside Diameter)*	**OD SIZE 0.1380 INCH**

** After entering the TPI value, the press of Thread Size is required in order to store the entered Thread Size.*

Fractional Thread Size – *Model 4086*

Enter a 1/2 Inch screw size and toggle through the available common Threads per Inch (displayed in the upper-right corner of the display) until 28 TPI is reached. Store the Thread Size and toggle through the available Thread characteristics.

KEYSTROKE	DISPLAY
On/C On/C	**0.**

1. Enter the Thread Size:

1 / 2 Thread Size	**SIZE 1/2 – INCH**

2. Toggle through the available common TPI values until 28 is displayed:

Thread Size	**THRED SIZE S 1/2 – 12 INCH**
Thread Size	**THRED SIZE S 1/2 – 13 INCH**
Thread Size	**THRED SIZE S 1/2 – 14 INCH**
Thread Size	**THRED SIZE S 1/2 – 16 INCH**
Thread Size	**THRED SIZE S 1/2 – 18 INCH**
Thread Size	**THRED SIZE S 1/2 – 20 INCH**
Thread Size	**THRED SIZE S 1/2 – 24 INCH**
Thread Size	**THRED SIZE S 1/2 – 27 INCH**
Thread Size	**THRED SIZE S 1/2 – 28 INCH**

KEYSTROKE	DISPLAY
3. Store selected Thread Size and find the recommended Cutting Tap Hole Size (Cut Tap Drill Size) and the Thread Outside Diameter (Minimum Major Diameter):	
On/C *	**0.**
Thread Size	**THRED S SIZE 1/2 – 28 INCH**
Thread Size *(Cut Tap Drill Size)*	**TAP DRILL SIZE 0-15/32 INCH**
Thread Size *(Outside Diameter)*	**OD SIZE 0.5000 INCH**

** In addition to clearing the display, pressing On/C upon reaching the desired TPI stores the displayed Thread Size.*

You can also directly enter a Threads per Inch value instead of toggling through the available ones. For this example, use a 3/8 Inch screw size with 16 TPI and toggle through the available Thread characteristics.

KEYSTROKE	DISPLAY
On/C On/C	**0.**
1. Enter the Thread Size:	
3 / 8 Thread Size	**SIZE 3/8– INCH**
2. Enter the TPI and store the final Thread Size:	
1 6 Thread Size *	**THRED SIZE S 3/8–16 INCH**
3. Find the recommended Cutting Tap Hole Size (Cut Tap Drill Size) and the Thread Outside Diameter (Minimum Major Diameter):	
Thread Size *(Cut Tap Drill Size)*	**TAP DRILL SIZE 0-5/16 INCH**
Thread Size *(Outside Diameter)*	**OD SIZE 0.3750 INCH**

** After entering the TPI value, the press of Thread Size is required in order to store the entered Thread Size.*

Metric Thread Size – *Model 4086*

Enter a 2 mm screw size and toggle through the available common Thread Pitches until 0.4 is reached. Store the Thread Size and toggle through the available Thread characteristics.

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KEYSTROKE	DISPLAY
On/C On/C	0.
1. Enter the Thread Size:	
2 mm Thread Size	SIZE 2. – MM
2. Toggle through the available common Thread Pitches:	
Thread Size	THRED SIZE S 2. – 0.25 MM
Thread Size	THRED SIZE S 2. – 0.4 MM
3. Clear the display and then recall the stored Thread Size:	
On/C *	0.
Thread Size	THRED SIZE S 2. – 0.4 MM
4. Find the recommended Cutting Tap Hole Size (Cut Tap Drill Size) and the Thread Outside Diameter (Minimum Major Diameter):	
Thread Size *(Cut Tap Drill Size)*	TAP DRILL SIZE 1.6 MM
Thread Size *(Outside Diameter)*	OD SIZE 2.0000 MM

** In addition to clearing the display, pressing On/C upon reaching the desired Pitch stores the displayed Thread Size.*

You can also directly enter a Thread Pitch instead of toggling through the available ones. For this example, use an 8 mm screw size with a Pitch of 0.75 mm and toggle through the available Thread characteristics.

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Enter the Thread Size:	
8 mm Thread Size	SIZE 8. – MM
2. Enter the Thread Pitch and store the final Thread Size:	
0 • 7 5 Thread Size *	THRED SIZE S 8. – 0.75 MM

KEYSTROKE	DISPLAY

3. Find the recommended Cutting Tap Hole Size (Cut Tap Drill Size) and the Thread Outside Diameter (Minimum Major Diameter).

Thread Size *Cut Tap Drill Size)* **TAP DRILL SIZE 7.25 MM**

Thread Size *(Outside Diameter)* **OD SIZE 8.0000 MM**

** After entering the Pitch value, the press of Thread Size is required in order to store the entered Thread Size.*

Thread Classification (NOT AVAILABLE ON MODEL 4086)

The *Machinist Calc Pro* provides additional outputs and gives you the choice between Internal and External Threads. Entering a U.S. Thread Size will allow you to choose among U.S. Thread Classes as shown below.

Thread Type	U.S. Thread Classes		
Internal	1B	2B*	3B
External	1A	2A	3A

Entering a Metric Thread will allow you to choose among Metric Thread Tolerance Classes as shown below.

Thread Type	Metric Thread Tolerance Classes						
Internal	3G 3H	4G 4H	5G 5H	6G 6H*	7G 7H	8G 8H	9G 9H
External	3g 3h 3e 3f	4g 4h 4e 4f	5g 5h 5e 5f	6g 6h 6e 6f	7g 7h 7e 7f	8g 8h 8e 8f	9g 9h 9e 9f

** Default settings*

Changing Thread Classes

To display the current Thread Classification, press Conv Bolt Pattern. Repeated presses of Bolt Pattern will toggle between External and Internal Thread Types. You can change the number of a Thread Class by entering the number of the desired class/grade and pressing Conv Bolt Pattern.

Changing a U.S. Thread Classification

KEYSTROKE	DISPLAY
Conv ✕	**ALL CLEArEd**
1. Recall the current Thread Classification:	
Conv Bolt Pattern *(Thread Class)*	**INT 2B**
2. Change to U.S. External Thread Class 2:	
Bolt Pattern	**EXT 2A**
3. Change to U.S. External Thread Class 1:	
1 Conv Bolt Pattern *(Thread Class)*	**EXT 1A**
4. Change to U.S. Internal Thread Class 1:	
Bolt Pattern	**INT 1B**

Changing a Metric Thread Classification

Changing a Metric Thread Tolerance Class is done in the same manner, with several selections available for Internal and External Threads.

KEYSTROKE	DISPLAY
Conv ✕	**ALL CLEArEd**
1. Enter a Tolerance Grade of 4:	
4 Conv Bolt Pattern *(Thread Class)*	**INT MM 4H**
2. Toggle through the available Tolerance Positions for the entered Grade:	
Bolt Pattern	**EXT MM 4G**
Bolt Pattern	**EXT MM 4H**
Bolt Pattern	**EXT MM 4E**
Bolt Pattern	**EXT MM 4F**
Bolt Pattern	**INT MM 4G**
Bolt Pattern	**INT MM 4H**

KEYSTROKE	DISPLAY
3. Enter a Tolerance Grade of 6 and toggle through the available Tolerance Positions for the entered Grade:	
6 Conv Bolt Pattern *(Thread Class)*	**INT MM 6H**
Bolt Pattern	**EXT MM 6G**
Bolt Pattern	**EXT MM 6H**
Bolt Pattern *	**EXT MM 6E**

** Repeated presses of Bolt Pattern will continue to toggle through the available Tolerance Positions of the specified Grade.*

Note: *The number 3 can be entered to select both U.S. and Metric classes. If no Thread Size is stored when accessing the Thread Classification function, the U.S. Class will always be displayed. In order to select a Tolerance Class with a Grade of 3 for a Metric Thread Size, the Metric Thread Size must be stored prior to accessing the Thread Classification function.*

Numeric Thread Size – *Model 4087*

Enter an 8-32 screw and toggle through the available Internal Thread (Class 2B) characteristics, then switch to External Thread (Class 2A) and toggle through the available Thread characteristics.

Note: *The default U.S. Thread Class is 2B (Internal). To view the current Thread Class, press Conv Bolt Pattern. To change the class, press Bolt Pattern again.*

Thread Size calculations for Pitch, Major, and Minor Diameter attributes are compliant with ANSI/ASME B.1.1-2003 and ANSI/ASME B.1.1.3M-2005.

KEYSTROKE	DISPLAY
Conv ⊠	**ALL CLEArEd**
1. Verify Thread Class is set to 2B:	
Conv Bolt Pattern *(Thread Class)*	**INT 2B**
2. Enter the Thread Size:	
8 Thread Size	**SIZE 8 –**

(cont'd)

KEYSTROKE	DISPLAY
3. Enter the TPI and store the final Thread Size:	
3 2 Thread Size	**THRED SIZE S 8 – 32**
4. Find the available Internal Thread characteristics:	
Thread Size *(Cut Tap Drill Size)*	**TAP DRILL SIZE 29**
Thread Size *(Roll Tap Drill Size)*	**R-TAP DRILL SIZE 3.75 MM**
Thread Size *(Close Fit Drill Size)*	**CLOSE DRILL SIZE 18**
Thread Size *(Free Fit Drill Size)*	**FREE DRILL SIZE 16**
Thread Size *(Min. Internal Pitch Diameter)*	**PTCH- SIZE 0.1437 INCH**
Thread Size *(Max. Internal Pitch Diameter)*	**PTCH+ SIZE 0.1475 INCH**
Thread Size *(Min. Internal Minor Diameter)*	**MINR- SIZE 0.1300 INCH**
Thread Size *(Max. Internal Minor Diameter)*	**MINR+ SIZE 0.1390 INCH**
Thread Size *(Min. Internal Major Diameter)*	**MAJR- SIZE 0.1640 INCH**
5. Switch to Thread Class 2A and find the available External Thread characteristics:	
Conv Bolt Pattern Bolt Pattern *(Thread Class)*	**EXT 2A**
Thread Size	**THRED SIZE S 8 – 32**
Thread Size *(Rod Size for thread cutting)*	**ROD SIZE 0.1640 INCH**
Thread Size *(Rod Size for cold forming)*	**CFORM SIZE 0.1450 INCH**
Thread Size *(Max. External Pitch Diameter)*	**PTCH+ SIZE 0.1428 INCH**
Thread Size *(Min. External Pitch Diameter)*	**PTCH- SIZE 0.1399 INCH**
Thread Size *(Max. External Major Diameter)*	**MAJR+ SIZE 0.1631 INCH**
Thread Size *(Min. External Major Diameter)*	**MAJR- SIZE 0.1571 INCH**
Thread Size *(Max. External Minor Diameter)*	**MINR+ SIZE 0.1259 INCH**

Fractional Thread Size – *Model 4087*

Find the available Internal and External Thread characteristics for a 1/4 Inch, 28 TPI screw.

KEYSTROKE	DISPLAY
Conv ⊠	**ALL CLEArEd**
1. Verify Thread Class is set to 2B:	
Conv Bolt Pattern *(Thread Class)*	**INT 2B**
2. Enter the Thread Size:	
1 / 4 Thread Size	**SIZE 1/4 – INCH**
3. Enter the TPI and store the final Thread Size:	
2 8 Thread Size	**THRED SIZE S 1/4 – 28 INCH**
4. Find the available Internal Thread characteristics:	
Thread Size *(Cut Tap Drill Size)*	**TAP DRILL SIZE 3**
Thread Size *(Roll Tap Drill Size)*	**R-TAP DRILL SIZE 5.9 MM**
Thread Size *(Close Fit Drill Size)*	**CLOSE DRILL SIZE F**
Thread Size *(Free Fit Drill Size)*	**FREE DRILL SIZE H**
Thread Size *(Min. Internal Pitch Diameter)*	**PTCH- SIZE 0.2268 INCH**
Thread Size *(Max. Internal Pitch Diameter)*	**PTCH+ SIZE 0.2311 INCH**
Thread Size *(Min. Internal Minor Diameter)*	**MINR- SIZE 0.2110 INCH**
Thread Size *(Max. Internal Minor Diameter)*	**MINR+ SIZE 0.2200 INCH**
Thread Size *(Min. Internal Major Diameter)*	**MAJR- SIZE 0.2500 INCH**
5. Switch to Thread Class 2A and find the available External Thread characteristics:	
Conv Bolt Pattern Bolt Pattern *(Thread Class)*	**EXT 2A**
Thread Size	**THRED SIZE S 1/4 – 28 INCH**
Thread Size *(Rod Size for Thread Cutting)*	**ROD SIZE 0.2500 INCH**
Thread Size *(Rod Size for Cold Forming)*	**CFORM SIZE 0.2283 INCH**
Thread Size *(Max. External Pitch Diameter)*	**PTCH+ SIZE 0.2258 INCH**
Thread Size *(Min. External Pitch Diameter)*	**PTCH- SIZE 0.2225 INCH**
Thread Size *(Max. External Major Diameter)*	**MAJR+ SIZE 0.2490 INCH**
Thread Size *(Min. External Major Diameter)*	**MAJR- SIZE 0.2425 INCH**
Thread Size *(Max. External Minor Diameter)*	**MINR+ SIZE 0.2065 INCH**

Metric Thread Size – *Model 4087*

Find the available Internal and External Thread characteristics for a 5 mm, 0.75 mm Pitch screw with a Tolerance Class of 4H.

Note: *The default Metric Tolerance Class is 6H (Internal). To view the current Tolerance Class, press* Conv Bolt Pattern *after entering the desired Metric Thread Size. To change the class, press* Bolt Pattern *again.*

KEYSTROKE	DISPLAY
Conv ✕	**ALL CLEArEd**
1. Set Tolerance Class to Internal 4H:	
4 Conv Bolt Pattern *(Thread Class)*	**INT MM 4H**
2. Enter the Thread Size:	
5 mm Thread Size	**SIZE 5. – MM**
3. Enter the Thread Pitch and store the final Thread Size:	
0 • 7 5 Thread Size	**THRED SIZE S 5. – 0.75 MM**
4. Find the available Internal Thread characteristics:	
Thread Size *(Cut Tap Drill Size)*	**TAP DRILL SIZE 4.25 MM**
Thread Size *(Roll Tap Drill Size)*	**R-TAP DRILL SIZE 14**
Thread Size *(Close Fit Drill Size)*	**CLOSE DRILL SIZE 5.3 MM**
Thread Size *(Free Fit Drill Size)*	**FREE DRILL SIZE 5.8 MM**
Thread Size *(Min. Internal Pitch Diameter)*	**PTCH- SIZE 4.5130 MM**
Thread Size *(Max. Internal Pitch Diameter)*	**PTCH+ SIZE 4.5605 MM**
Thread Size *(Min. Internal Minor Diameter)*	**MINR- SIZE 4.1880 MM**
Thread Size *(Max. Internal Minor Diameter)*	**MINR+ SIZE 4.3060 MM**
Thread Size *(Min.Internal Major Diameter)*	**MAJR- SIZE 5.0000 MM**
5. Switch to External 4g Tolerance Class and find the available External Thread characteristics:	
Conv Bolt Pattern Bolt Pattern *(Thread Class)*	**EXT MM 4G**
Thread Size	**THRED SIZE S 5. – 0.75 MM**
Thread Size *(Rod Size for Thread Cutting)*	**ROD SIZE 5.0000 MM**

KEYSTROKE	DISPLAY
Thread Size *(Rod Size for Cold Forming)*	**CFORM SIZE 4.5433 MM**
Thread Size *(Max. External Pitch Diameter)*	**PTCH+ SIZE 4.4910 MM**
Thread Size *(Min. External Pitch Diameter)*	**PTCH- SIZE 4.4350 MM**
Thread Size *(Max. External Major Diameter)*	**MAJR+ SIZE 4.9780 MM**
Thread Size *(Min. External Major Diameter)*	**MAJR- SIZE 4.8880 MM**
Thread Size *(Max. External Minor Diameter)*	**MINR+ SIZE 4.1660 MM**

Custom Thread Percentage (NOT AVAILABLE ON MODEL 4086)

The *Machinist Calc* and *Machinist Calc Pro* use a default Thread Grip Percentage of 75% when calculating Tap Drill sizes. With the custom Percentage Thread function on the *Machinist Calc Pro*, you can enter a different value to calculate Tap Drill sizes.

Calculate the Tap Drill Size for a 1/4 Inch, 26 TPI screw, then change the Thread Grip Percentage to 50% and calculate the new Tap Drill Size.

KEYSTROKE	DISPLAY
Conv ✕	**ALL CLEArEd**
1. Enter the Thread Size and calculate the Cut Tap and Roll Tap Drill Sizes:	
1 / 4 Thread Size	**SIZE 1/4 – INCH**
2 6 Thread Size	**THRED SIZE S 1/4 – 26 INCH**
Thread Size *(Cut Tap Drill Size)*	**TAP DRILL SIZE 3**
Thread Size * *(Roll Tap Drill Size)*	**R-TAP DRILL SIZE 5.9 MM**
2. Change the Thread Grip Percentage to 50% and calculate the new Cut Tap and Roll Tap Drill Sizes:	
5 0 Conv Thread Size *(% Thread)*	**THRD% SIZE S 50.**
Thread Size	**THRED SIZE S 1/4 – 26 INCH**
Thread Size *(Cut Tap Drill Size)*	**TAP DRILL SIZE 1**
Thread Size * *(Roll Tap Drill Size)*	**R-TAP DRILL SIZE 6. MM**

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** Repeated presses of Thread Size will toggle through the inputs and outputs, starting with the Close Fit Drill Size.*

WIRE SIZES AND 3-WIRE MEASUREMENTS

(NOT AVAILABLE ON MODEL 4086)

Wire Size

If you know your Thread Size, you can find the Best (Ideal), Maximum and Minimum Wire Sizes you can use for that size Screw Thread.

Find the Ideal (Best), Maximum and Minimum Wire Sizes for measuring a 3/8 Inch Thread with 16 Threads per Inch:

KEYSTROKE	DISPLAY
On/C On/C	**0.**
1. Enter the Thread Size:	
3 / 8 Thread Size	**SIZE 3/8 – INCH**
2. Enter the Threads per Inch and store the final Thread Size:	
1 6 Thread Size	**THRED SIZE S 3/8 – 16 INCH**
3. Find the Ideal (Best), Maximum and Minimum Wire Sizes:	
Conv Feed Rate *(Wire Size)*	**BEST SIZE 0.0361 INCH**
Feed Rate	**MAX SIZE 0.0563 INCH**
Feed Rate	**MIN SIZE 0.0350 INCH**

3-Wire Measurement – *Known Thread Size and Wire Size*

You can find the 3-Wire Measurement as well as the Pitch Diameter if you know the Thread Size and the Wire Size you want to use.

Note: *When solving for 3-Wire Measurement and Pitch Diameter, the Thread Classification must be set to an External Thread Type. Otherwise, no solutions will be provided when set to an Internal Thread Type.*

Find the maximum allowable 3-Wire Measurement and Pitch Diameter for a 3/8 – 16, Class 2A (External) screw using 0.040 Inch wire:

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Enter the Thread Size:	
3 / 8 Thread Size	SIZE 3/8 – INCH
2. Enter the Threads per Inch and store the final Thread Size:	
1 6 Thread Size	THRED SIZE S 3/8 – 16 INCH
3. Set the Thread Class to 2A:	
2 Conv Bolt Pattern * *(Thread Class)*	EXT 2A

** If necessary, continue pressing Bolt Pattern until the desired External Thread Class is displayed.*

*4. Enter the Wire Size**:*

• 0 4 Conv Feed Rate *(Wire Size)* — **WIRE SIZE S 0.04 INCH**

5. Find the Maximum 3-Wire Measurement:

Conv RPM *(3-W Measure)* — **3WIRE SIZE 0.3990 INCH**

6. Find the Pitch Diameter:

RPM — **P-DIA SIZE 0.3331 INCH**

RPM — **WIRE SIZE S 0.04 INCH**

*** If no Wire Size is entered, the calculated Best (Ideal) Wire Size will be used to find the 3-Wire Measurement.*

Pitch Diameter – *Known 3-Wire Measurement and Wire Size*

You can also find the measured Pitch Diameter if you know the 3-Wire Measurement and the Wire Size used to obtain the measurement.

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Find the Pitch Diameter of a 3/8-16, Class 2A (External) screw with a 3-Wire Measurement of 0.3975 Inches obtained using a 0.040 Inch wire:

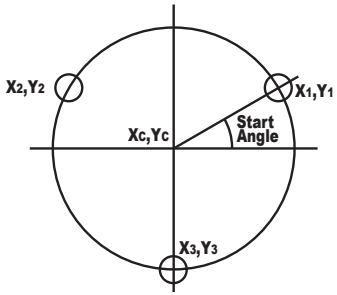
KEYSTROKE	DISPLAY
On/C On/C	0.
1. Enter the Thread Size:	
3 / 8 Thread Size	SIZE 3/8 – INCH
2. Enter the Threads per Inch and store the final Thread Size:	
1 6 Thread Size	THRED SIZE S 3/8 – 16 INCH
3. Enter the Wire Size:*	
• 0 4 Conv Feed Rate *(Wire Size)*	WIRE SIZE S 0.04 INCH
4. Enter the 3-Wire Measurement:	
• 3 9 7 5 Conv RPM *(3-W Measure)*	3WIRE SIZE S 0.3975 INCH
5. Find the Pitch Diameter:	
RPM	P-DIA SIZE 0.3316 INCH
RPM	WIRE SIZE S 0.04 INCH

** If no Wire Size is entered, the calculated Best (Ideal) Wire Size will be used to find the Pitch Diameter.*

BOLT PATTERN

With the *Machinist Calc* and *Machinist Calc Pro*, you can determine a Bolt Pattern by entering the Bolt Circle Diameter, the Number of Bolt Holes and the Angle of the first bolt hole (optional). The *Machinist Calc Pro* offers the added ability to enter an optional Center x and y-coordinate of the Bolt Pattern.

In addition to calculating the x and y-coordinates for each bolt hole, the Bolt Pattern function also calculates the hole center-to-center spacing (i.e. on-center distance from hole to hole).



Bolt Pattern – *Model 4086*

Calculate the Bolt Pattern for a layout with a 4.5 Inch Diameter, a 30° Start Angle and 6 Bolts.

Note: *When determining angles, 0° is at the 3 o'clock position and the rotation goes counterclockwise.*

KEYSTROKE	DISPLAY
On/C On/C	**0.**
1. Enter the Angle of the first bolt hole:	
3 0 Conv Bolt Pattern *(Start Angle)*	**ANGLE S 30.°**
2. Enter the Bolt Circle Diameter:	
4 • 5 Inch Diam	**DIA S 4.5 INCH**
3. Enter the Number of Bolts:	
6 Bolt Pattern	**BOLTS S 6.**
4. Calculate the hole Center-to-Center Spacing and the x and y coordinates:	
Bolt Pattern *(Center-to-Center Spacing)*	**OC-OC 2.2500 INCH**
Bolt Pattern	**X-01 1.9486 INCH**
Bolt Pattern	**Y-01 1.1250 INCH**
Bolt Pattern	**X-02 0.0000 INCH**
Bolt Pattern	**Y-02 2.2500 INCH**

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KEYSTROKE	DISPLAY
Bolt Pattern	X-03 - 1.9486 INCH
Bolt Pattern	Y-03 1.1250 INCH
Bolt Pattern	X-04 - 1.9486 INCH
Bolt Pattern	Y-04 - 1.1250 INCH
Bolt Pattern	X-05 0.0000 INCH
Bolt Pattern	Y-05 - 2.2500 INCH
Bolt Pattern	X-06 1.9486 INCH
Bolt Pattern	Y-06 - 1.1250 INCH
Bolt Pattern	DIA S 4.5 INCH
Bolt Pattern	ANGLE S 30°

Bolt Pattern – ***Model 4087***

Calculate the Bolt Pattern for a layout with a 3.5 Inch Diameter, a 20° Start Angle and 3 Bolts. The Center x-coordinate is 10 inches and the center y-coordinate is 15 inches.

Note: *When determining angles, 0° is at the 3 o'clock position and the rotation goes counterclockwise.*

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Enter the Center x-coordinate:	
1 0 Inch Adj	ADJ S 10 INCH
2. Enter the Center y-coordinate:	
1 5 Inch Opp	OPP S 15 INCH
3. Enter the Start Angle:	
2 0 Angle	ANGLE S 20.°
4. Enter Bolt Circle Diameter:	
3 • 5 Inch Diam	DIA S 3.5 INCH
5. Enter the Number of Bolts:	
3 Bolt Pattern	BOLTS S 3.

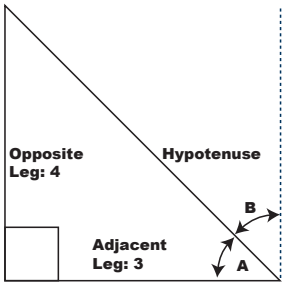
KEYSTROKE	DISPLAY
6. Calculate Center-to-Center Spacing and the x and y coordinates:	
Bolt Pattern *(Center-to-Center Spacing)*	**OC-OC 3.0311 INCH**
Bolt Pattern	**X-01 11.6445 INCH**
Bolt Pattern	**Y-01 15.5985 INCH**
Bolt Pattern	**X-02 8.6594 INCH**
Bolt Pattern	**Y-02 16.1249 INCH**
Bolt Pattern	**X-03 9.6961 INCH**
Bolt Pattern	**Y-03 13.2766 INCH**
Bolt Pattern	**DIA S 3.5 INCH**
Bolt Pattern	**Xoc S 10 INCH**
Bolt Pattern	**Yoc S 15 INCH**
Bolt Pattern	**ANGLE S 20°**

RIGHT TRIANGLE FUNCTIONS (NOT AVAILABLE ON MODEL 4086)

With the *Machinist Calc Pro*, you can easily solve Right Triangle problems by simply entering two of four variables: Adjacent, Opposite, Hypotenuse or Angle.

Right Triangle – *Based on Adjacent and Opposite Legs*

Calculate the Hypotenuse, Angle and Adjacent Angle of a right triangle with an Adjacent Leg of 3 Inches and an Opposite Leg of 4 Inches:



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KEYSTROKE	DISPLAY
On/C On/C	**0.**
1. Enter the Adjacent Leg length:	
3 Inch Adj	**ADJ S 3. INCH**
2. Enter the Opposite Leg length:	
4 Inch Opp	**OPP S 4. INCH**
3. Solve for the Hypotenuse:	
Hyp	**HYP 5 INCH**
4. Solve for the Angle:	
Angle	**ANGLE S 53.130102°**
5. Solve for the Adjacent Angle:	
Angle	**ADJ<Ø 36.8699°**

Right Triangle – *Based on Hypotenuse and Angle*

Calculate the Adjacent Angle, Adjacent Leg and Opposite Leg of a right triangle with a Hypotenuse of 12 Inches and a known Angle of 35.34°:

KEYSTROKE	DISPLAY
On/C On/C	**0.**
1. Enter the Hypotenuse:	
1 2 Inch Hyp	**HYP S 12. INCH**
2 Enter the known Angle:	
3 5 • 3 4 Angle	**ANGLE S 35.34°**
3. Solve for the Adjacent Angle:	
Angle	**ADJ<Ø 54.6600°**
4. Solve for the Adjacent Leg:	
Adj	**ADJ 9-25/32 INCH**
5. Solve for the Opposite Leg:	
Opp	**OPP S 6-15/16 INCH**

CIRCLE CALCULATIONS

Circumference and Area – *Based on Diameter*

Find the Area, Circumference and Radius of a circle with a Diameter of 11 Inches:

KEYSTROKE	DISPLAY
On/C On/C	0.
1 1 Inch Diam	DIA S 11 INCH
Diam	AREA 95.0332 SQ INCH
Diam	CIRC 34-9/16 INCH
Conv Diam *(Radius)*	RAD S 5-1/2 INCH

Circumference and Area – *Based on Radius*

(NOT AVAILABLE ON MODEL 4086)

Find the Diameter, Area and Circumference of a circle with a Radius of 3-1/4":

KEYSTROKE	DISPLAY
On/C On/C	0.
3 Inch 1 / 4 Conv Diam *(Radius)*	RAD S 3-1/4 INCH
Diam	DIA S 6-1/2 INCH
Diam	AREA 33.1831 SQ INCH
Diam	CIRC 20-27/64 INCH

BASIC D:M:S AND TRIGONOMETRY EXAMPLES

Converting Degrees:Minutes:Seconds

Convert 23° 42’ 39” to decimal degrees:

KEYSTROKE	DISPLAY
On/C On/C	0.
2 3 • 4 2 • 3 9	DMS 23.42.39
Conv • *(dms◄►deg)*	23.710833°

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Convert 44.29° to degrees:minutes:seconds format:

KEYSTROKE	DISPLAY
On/C On/C	0.
4 4 • 2 9 Conv • *(dms◄►deg)*	DMS 44.17.24°

Note: *Improperly formatted entries will be redisplayed in the correct convention after any operator key is pressed. For example, 30° 89' entered will be corrected and displayed as 31° 29' 0" or 31.483333°.*

Time Calculations Using D:M:S

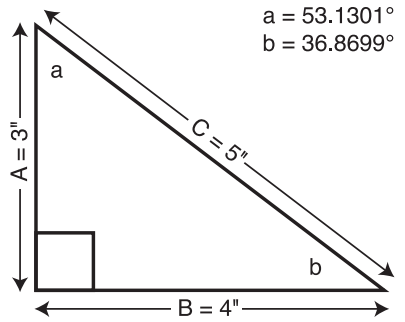
Add 7 Hours 45 Minutes 33 Seconds to 11 Hours 16 Minutes 20 Seconds:

KEYSTROKE	DISPLAY
On/C On/C	0.
7 • 4 5 • 3 3 +	DMS 7.45.33°
1 1 • 1 6 • 2 0 =	DMS 19.01.53°

Trigonometric Functions (NOT AVAILABLE ON MODEL 4086)

Trigonometric functions are available on the *Machinist Calc Pro* calculator.

The following drawing and formulas list basic trigonometric formulas, for your reference:



Given side A and angle a, find:

Side C A ÷ a Conv Feed/Tooth *(Cos)* =

(e.g., 3 Inch ÷ 5 3 • 1 3 Conv Feed/Tooth *(Cos)* =)

Side B A × a Conv Cut Feed *(Tan)* =

Angle b 90° − a =

Given side A and angle b, find:

Side B A ÷ b Conv Cut Feed *(Tan)* =

Side C A ÷ b Conv #Teeth *(Sine)* =

Angle a 90° − b =

Given side B and angle a, find:

Side A B ÷ a Conv Cut Feed *(Tan)* =

Side C B ÷ a Conv #Teeth *(Sine)* =

Given side C and angle a, find:

Side A C × a Conv Feed/Tooth *(Cos)* =

Side B C × a Conv #Teeth *(Sine)* =

Given side A and side C, find:

Angle a A ÷ C = Conv Opp/Hyp *(ArcCos)*

Angle b A ÷ C = Conv Adj/Hyp *(ArcSine)*

Given side B and angle b, find:

Side C B ÷ b Conv Feed/Tooth *(Cos)* =

Side A B × b Conv Cut Feed *(Tan)* =

APPENDIX A – *DEFAULT SETTINGS*

After a Clear All (Conv ⊠), your calculator will return to the following settings:

STORED VALUES	DEFAULT VALUE
Number of Teeth	**1.**
Drill Point Angle	**118°**
Weight per Volume	**490 pounds per cubic foot**
MODEL 4087 ONLY:	
% Thread	**75%**
Thread Classification	
US Threads	**Internal 2B**
Metric Threads	**Internal 6H**

If you replace your batteries or perform a Full Reset* (press Off, hold down ⊠ and press On/C) your calculator will return to the following settings (in addition to those listed above):

PREFERENCE SETTINGS	DEFAULT VALUE
Fractional Resolution	**1/64”**
Functional Result Rounding	**0.0000**
Default Unit Format	**US**
Area Answer Format	**Standard**
Volume Answer Format	**Standard**
Fractional Mode	**Standard**
Mathematical Operation	**Order of Operations Method**

** Depressing the Reset button located above the Cut Speed key will also perform a Full Reset.*

APPENDIX B – *PREFERENCE SETTINGS*

The *Machinist Calc* and *Machinist Calc Pro* have Preference Settings that allow you to customize or set desired unit formats and calculations. If you replace your batteries or perform a Full Reset* (press Off, hold down ⊠, and press On/C), your calculator will return to the following settings (in addition to those listed on the previous page), with the default setting for each preference listed first:

** Depressing the Reset button located above the Cut Speed key will also perform a Full Reset.*

PREFERENCE	OPTIONS
1) Fractional Resolution	**– 1/64:** displays fractional values to the nearest 64th of an Inch. **– 1/2:** displays fractional values to the nearest half Inch. **– 1/4:** displays fractional values to the nearest quarter of an Inch. **– 1/8:** displays fractional values to the nearest 8th of an Inch. **– 1/16:** displays fractional values to the nearest 16th of an Inch. **– 1/32:** displays fractional values to the nearest 32nd of an Inch.
2) Functional Result Rounding	**– 0.0000:** calculation results using Machinist functions are displayed to four decimal places. **– 0.000:** calculation results using Machinist functions are displayed to three decimal places. **– FLOAT:** calculation results using Machinist functions are always displayed to the maximum number of decimal places.

(cont'd)

(cont'd)

3) Default Unit Format

– **US:** unitless values stored within Machinist functions are automatically assigned the corresponding default U.S. units of the selected function.
– **METRIC:** unitless values stored within the Machinist functions are automatically assigned the corresponding default Metric units of the selected function.

4) Area Answer Format

– **Standard:** if units entered are the same – e.g., Feet x Feet – area answers will remain in this format (Square Feet), but if units entered are different – e.g., Inches x Feet – area answers will be displayed in Square Feet.
– **Square Feet:** area answers always displayed in Square Feet, regardless of unit entry – e.g., Inches x Inches = Square Feet.
– **Square Inches:** area answers always displayed in Square Inches, regardless of unit entry – e.g., Feet x Feet = Square Inches.
– **Square Meters:** area answers always displayed in Square Meters, regardless of unit entry – e.g., Feet x Feet = Square Meters.

5) Volume Answer Format

– **Standard:** if units entered are the same – e.g., Feet x Feet x Feet – the answer will remain in this format (Cubic Feet), but if units entered are different – e.g., Feet x Feet x Inches – volume answer will be displayed in Cubic Feet.
– **Cubic Feet:** volume answers always displayed in Cubic Feet, regardless of unit entry – e.g., Inches x Inches x Inches = Cubic Feet.
– **Cubic Meters:** volume answers always displayed in Cubic Meters, regardless of unit entry – e.g., Feet x Feet x Feet = Cubic Meters.
– **Cubic Inches:** volume answers always displayed in Cubic Inches, regardless of unit entry – e.g., Feet x Feet x Feet = Cubic Inches.

6) Fractional Mode

– **Standard:** fractions are displayed to the nearest fraction.
– **Constant:** fractions are displayed in the set Fractional Resolution.

7) Mathematical Operation

– **Order:** the calculator uses the Order of Operations Method (10 + 4 x 5 = 30).
– **Chain:** the calculator uses the Chaining Method (as entered: 10 + 4 x 5 = 70).

APPENDIX C – *CARE INSTRUCTIONS*

Please follow the guidelines listed in this section for proper care and operation of your calculator. Not following the instructions listed below may result in damage not covered by your warranty. Refer to the ***WARRANTY*** section on page 69 for more details.

Do not expose calculator to temperatures outside the operating temperature range of 32ºF – 104ºF (0ºC – 40ºC).

Do not expose calculator to high moisture such as submersion in water, heavy rain, etc.

APPENDIX D – *ACCURACY/ERRORS, AUTO SHUT-OFF, BATTERIES, RESET*

ACCURACY/ERRORS

Accuracy/Display Capacity — Your calculator has a twelve-digit display made up of eight digits (normal display) and four fractional digits. You may enter or calculate values up to 99,999,999.99. Each calculation is carried out internally to 12 digits.

Errors — When an incorrect entry is made, or the answer is beyond the range of the calculator, an error message will display. To clear an error condition you must press the On/C key once. At this point, you must determine what caused the error and re-key the problem.

Error Codes

DISPLAY	ERROR TYPE
OFLO	Overflow (too large)
MATH Error	Divide by 0
DIM Error	Dimension error
ENT Error	Invalid entry error
NONE	Attempt to access cleared Thread Size or Drill Size Value

Auto-Range — If an "overflow" is created because of an input and calculation with small units that are out of the standard eight-digit range of the display, the answer will be automatically expressed in the next larger units (instead of showing "**OFLO**") — e.g., 200,000,000 mm is shown as 200,000 m. Also applies to inches and feet.

AUTO SHUT-OFF

Your calculator is designed to shut itself off after about 8-12 minutes of non-use.

BATTERIES

The *Machinist Calc* and *Machinist Calc Pro* use two LR-44 batteries. Should your calculator display become very dim or erratic, replace the batteries.

Note: *Please use caution when disposing of your old batteries, as they contain hazardous chemicals.*

Replacement batteries are available at most discount or electronics stores. You may also call Calculated Industries at **1-775-885-4900**.

Battery Replacement Instructions

To replace the batteries, slide open the battery door (at top backside of unit) and replace with new batteries. Make sure the batteries are facing positive side up.

RESET

If your calculator should ever "lock up," press Reset – a small hole located above the Cut Speed key – to perform a total reset.

REPAIR AND RETURN

RETURN GUIDELINES

1. Please read the ***Warranty*** in this User's Guide to determine if your Calculated Industries product remains under warranty **before** calling or returning any device for evaluation or repairs.
2. If your product won't turn on, check the batteries as outlined in the User's Guide.
3. If you need more assistance, please go to the website listed below.
4. If you believe you need to return your product, please call a Calculated Industries representative between the hours of 7:00am to 4:30pm Pacific Time for additional information and a Return Merchandise Authorization (RMA).

Call Toll Free: 1-800-854-8075

Outside USA: 1-775-885-4900

www.calculated.com/warranty

WARRANTY

Warranty Repair Service – U.S.A.

Calculated Industries ("CI") warrants this product against defects in materials and workmanship for a period of **one (1) year from the date of original consumer purchase in the U.S.** If a defect exists during the warranty period, CI at its option will either repair (using new or remanufactured parts) or replace (with a new or remanufactured calculator) the product at no charge.

THE WARRANTY **WILL NOT APPLY** TO THE PRODUCT IF IT HAS BEEN DAMAGED BY MISUSE, ALTERATION, ACCIDENT, IMPROPER HANDLING OR OPERATION, OR IF UNAUTHORIZED REPAIRS ARE ATTEMPTED OR MADE. SOME EXAMPLES OF DAMAGES NOT COVERED BY WARRANTY INCLUDE, BUT ARE NOT LIMITED TO, BATTERY LEAKAGE, BENDING, A BLACK "INK SPOT" OR VISIBLE CRACKING OF THE LCD, WHICH ARE PRESUMED TO BE DAMAGES RESULTING FROM MISUSE OR ABUSE.

To obtain warranty service in the U.S., please go to the website. A repaired or replacement product assumes the remaining warranty of the original product or 90 days, whichever is longer.

Non-Warranty Repair Service – U.S.A.

Non-warranty repair covers service beyond the warranty period, or service requested due to damage resulting from misuse or abuse. Contact Calculated Industries at the number listed above to obtain current product repair information and charges. Repairs are guaranteed for 90 days.

Repair Service – Outside the U.S.A.

To obtain warranty or non-warranty repair service for goods purchased outside the U.S., contact the dealer through which you initially purchased the product. If you cannot reasonably have the product repaired in your area, you may contact CI to obtain current product repair information and charges, including freight and duties.

Disclaimer

CI MAKES NO WARRANTY OR REPRESENTATION, EITHER EXPRESS OR IMPLIED, WITH RESPECT TO THE PRODUCT'S QUALITY, PERFORMANCE, MERCHANTABILITY, OR FITNESS

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Some states do not allow the exclusion or limitation of implied warranties or liability for incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific rights, and you may also have other rights, which vary from state to state.

FCC Class B

This equipment has been certified to comply with the limits for a Class B calculating device, pursuant to Subpart J of Part 15 of FCC rules.

Legal Notes

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Looking for New Ideas

Calculated Industries, a leading manufacturer of special-function calculators and digital measuring instruments, is always looking for new product ideas in these areas.

If you have a new product idea, please visit our "Bright Idea" page at www.calculated.com/brightidea.asp. For suggestions about improving this product or other products, please visit us at www.calculated.com under "Contact Us". Thank You.

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